Health Risks from Consuming Fish Caught or Raised in a Dioxin-Contaminated Hotspot, Vietnam

Bien Hoa Airbase
Vietnam

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Objective

- Review levels of TCDD dioxin in fish samples collected at Bien Hoa Airbase in 2010.
- Assess which alternatives for consuming fish from the base could be protective of public health:
  - A ban on fishing for any purpose (either for human or animal consumption)
  - A ban on human consumption of fish
  - A restriction that people not consume internal organs or the skin of fish

Background

- Agent Orange, a defoliant used by the U.S. during the U.S.-Vietnam war was contaminated with 2,3,7,8-TCDD.
- TCDD is lipophilic and can bioaccumulate.
- Exposure to TCDD has been associated with cancer, dermatologic, developmental, reproductive, and neurologic effects.
- TCDD *hot-spots* still exist in Vietnam, the most significant are former U.S. Air Force bases at Da Nang, Bien Hoa, and Phu Cat.
- The U.S. and Vietnam governments, the UNDP, and others are moving forward with clean-up.
- Stopping on-going exposures to people working on or living near these hotspots is a high priority.
- Consumption of contaminated fish and other foods is the most significant remaining open exposure pathway.

Background (continued)

- Hatfield Consultants and GVN (Office 33) released an assessment of the Bien Hoa Airbase in 2011.
  - Storage, handling, loading, and spillage of Agent Orange resulted in subsequent contamination of soils and sediments.
  - Several on-base ponds and lakes receive runoff from contaminated areas of the base.
  - Some ponds are used for raising fish and ducks for human consumption.
  - Tilapia samples collected in, or on the perimeter of, the airbase had significantly higher TCDD concentrations than samples collected from markets in the city.

Methods

- ATSDR used sampling results from the Hatfield/Office 33 report
- Health assessment was conducted according to the guidance that ATSDR uses for evaluations at all hazardous waste sites (ATSDR 2005).
- ATSDR chronic oral minimal risk level = 1 picogram 2,3,7,8-TCDD/kg/day
  - The MRL is an estimate of daily human exposure to a hazardous substance likely without an appreciable risk of adverse, non-cancer health effects. This MRL is based on a minimal LOAEL for neurodevelopmental effects in off-spring of dosed rhesus monkeys and a "safety" factor of 100.
- Assumptions
  - Average fish consumption was 94 g/day
  - 95th percentile fish consumption was 170 g/day
  - 70 Kg man
  - ([TCDD food ppt] * consumption g/day)/ 70 Kg = TCDD picograms/Kg/day

2007 Mekong River Commission estimated annual per-capita inland consumption of fish was 34.5 Kg. 95th percentile defined by ATSDR PHA guidelines.

TCDD concentrations in fish at Bien Hoa Airbase, Vietnam 2010

On base 2,3,7,8 TCDD Concentrations (ppt) of Muscle and Fat

Tissue Type	Number	Mean	95% Lower CL	95% Upper CL	Maximum
Muscle	6	20.6	8.26	33.0	32.7
Fat	6	1830	470	3190	3990

On Base whole Fish Concentrations (ppt) 2,3,78 TCDD

Location	Concentration
Pacer Ivy Whole Fish	618
Z-1 Lake	94.7

Mr. Hoc lake at Bien Hoa Airbase 2011

Table 5: Calculated 2,3,7,8-TCDD Doses Bien Hoa Airbase Tilapia Samples

Consumption Scenario	Mean Dose	95% Lower Confidence Limit	95% Upper Confidence Limit	Maximum
Muscle Only at 94 g/day	28 pg/kg/day	11 pg/kg/day	44 pg/kg/day	44 pg/kg/day
Muscle Only at 170 g/day	50 pg/kg/day	20 pg/kg/day	80 pg/kg/day	80 pg/kg/day
Whole Fish (assuming 95% muscle, 5% fat) at 94 g/day	150 pg/kg/day	42 pg/kg/day	260 pg/kg/day	310 pg/kg/day
Whole Fish (assuming 95% muscle, 5% fat) at 170 g/day	270 pg/kg/day	76 pg/kg/day	460 pg/kg/day	560 pg/kg/day
Pacer Ivy Whole Fish at 94 g/day	830 pg/kg/day	NA	NA	NA
Pacer Ivy Whole Fish at 170 g/day	1500 pg/kg/day	NA	NA	NA
Z-1 Lake 94 g/day	130 pg/kg/day	NA	NA	NA
Z-1 Lake 170 g/day	230 pg/kg/day	NA	NA	NA

Health Benchmarks for Dioxin TEQs from Around the World.

Organization	TDI	Countries
WHO (1998)	1-4 pg TEQ/kg/day	France Germany Netherlands New Zealand
JEA (1999)	4 pg TEQ/kg/day	Japan
COT (2001)	2 pg TEQ/ kg/day	UK
JECFA (2001)	2.3 pg TEQ/kg/day i.e.,70 pg TEQ/kg/month	Australia Canada
US EPA (2012)	0.7 pg/kg/day	USA

WHO = World Health Organization; JEA = Japanese Environmental Agency ; COT = Committee on the Toxicity of Chemicals in Food ; JECFA = Joint (FAO/WHO) Expert Committee on Food Additives; FAO = Food and Agriculture Committee of the United Nations ; US EPA = Un ited States Environmental Protection Agency

Conclusions

People who consume the flesh from Bien Hoa fish in amounts equivalent to the average intake of fish per day, ingest between 11 and 46 times the tolerable daily intake.

People who consume flesh with 5% fat from Bien Hoa fish in amounts equivalent to the average intake of fish per day, ingest between 42 and 310 times the tolerable daily intake.

Human consumption of tilapia farmed at Bien Hoa airbase is a public health hazard.

Prohibition of farming of fish (and poultry) in contaminated ponds at Bien Hoa should be strictly monitored. It should not be re-established until adequate clean-up has occurred.

The contaminated fish should not be used in any manner that would result in bioaccumulation into the food supply.